GROWTH RATES AND SEX RATIOS OF RED-WINGED BLACKBIRD NESTLINGS

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The mean growth in weight and tarsus length for male and female Red-winged Blackbird (*Agelaius phoeniceus*) nestlings has been reported by Williams (1940). Holcomb and Twiest will report elsewhere on Redwing nestling mean growth and growth "rate." It was found that there was no difference in growth of Redwing nestlings raised either in a marsh or an upland habitat. There was some brood reduction, however, in the upland habitat. It is important to establish that Redwing nestlings grew at the same rate in upland and marshes because this paper reports growth of birds from both environments analyzed together.

Allen (1914), Beer and Tibbitts (1950), Meanley and Webb (1963), Nero (1956), and Orians (1961) have documented beyond any doubt that the Redwing is polygamous. A male usually has between one and three females in his territory; two is most common. This suggests an adult female-male ratio of 2:1. First-year males, however, do not usually breed, and since there is not adequate knowledge about the fraction of first-year females breeding, one cannot say that there are two adult females for every male.

In this paper the objectives are to 1) discover whether there is a difference in *growth rate* (as presented by Brody, 1945; Dawson and Evans, 1957, 1960; Banks, 1959; and Maher, 1964) in weight of male and female nestling Redwings, 2) show the mean growth and rate of growth in weight and body parts of male and female nestlings, 3) show the time of feather capsule projection and fringing and growth of feathers in eight major feather tracts of male and female nestlings, 4) show the growth of body parts, each of which contributes to ontogeny of behavior, and 5) evaluate methods of sexing nestling Redwings by weight, and to show some reasons why a difference may exist in the adult ratio of males and females.

METHODS AND PROCEDURES

The study was done at a marsh at Battle Creek, Michigan, in 1965 and in an upland region in Toledo, Ohio, in 1964 and 1965. The nests were visited at least once each day. With few exceptions, a nest was visited at 24 ± 1 hour intervals. Nestlings were marked in the sequence of hatching by placing fingernail polish on their claws (claw 1, 2, etc.). New polish was added as it became worn. The weight was obtained to the nearest one-tenth gram on a double-beam balance after the nestling had been handled sufficiently to cause voiding of wastes.

Measurements of growth were made on the following parts of nestlings:

toe span—distance from the tip of toe one to the tip of toe three when extended; nearest mm. This characteristic is important in the development of the righting reflex and allowing the nestling to grasp and balance (Holcomb, 1966).

total body length—distance from the anterior tip of the culmen to the tip of the tail (including rectrices when present)—nearest mm

tarsus—nearest one-half mm

wing—radiale region to the tip of the phalanges (before feathers were present) and to the tip of primary eight after it emerged (wing chord)—nearest mm

Three head portions were measured so that observers studying behavior of gaping as a parental stimulus could refer to more than one standard.

mandibular tomium—distance from the anterior tip of the lower mandible to the commissural point—nearest mm

mandible tip (culmen) to nostril opening—distance from the anterior tip of the culmen to the anterior edge of the nostril opening—nearest one-half mm

gape width—distance across the base of head from one commissural point to the other—nearest mm

Each of the eight feather tract regions were examined each day and if one feather capsule had pushed through the epidermis it was recorded as *projecting*. After the feather capsules had projected, they were examined each day, to determine when the capsule was broken and feather barbs were visible. This was called "fringing" of the feather capsule.

One feather was measured from each of eight tracts each day after projection occurred. In most tracts one could not be sure that the same feather was measured each day, but the feathers were so near the same length in an area that the choice of different feathers should affect the mean values very little.

The following feathers were measured to the nearest mm:

caudal tract—left outermost rectrix

alar tract—first (most proximal) primary (left wing)

humeral tract—the longest feather—(usually found in the middle of the tract running parallel with the body)

capital tract—center of the coronal region

spinal tract—longest feather in the interscapular region

ventral tract—longest feather in the axillar region

crural tract—longest feather in the mid-portion of the anterior side of the leg

femoral tract—longest feather in the mid-portion.

Wetherbee (1957) describes the regions from which feathers were measured in this study and Holcomb and Twiest will publish a report containing a figure showing the exact locations.

The mean and standard errors were calculated for all of the measurements. The b values (regression coefficients) for the slopes of the growth curves for weight were calculated and a two-sided Students' t-test was used for determining significance ($p < 0.05$).

Growth in Redwings over the entire nestling period was nonlogarithmic. Thus, in determining growth rate, the formula presented by Banks (op. cit.) was used.

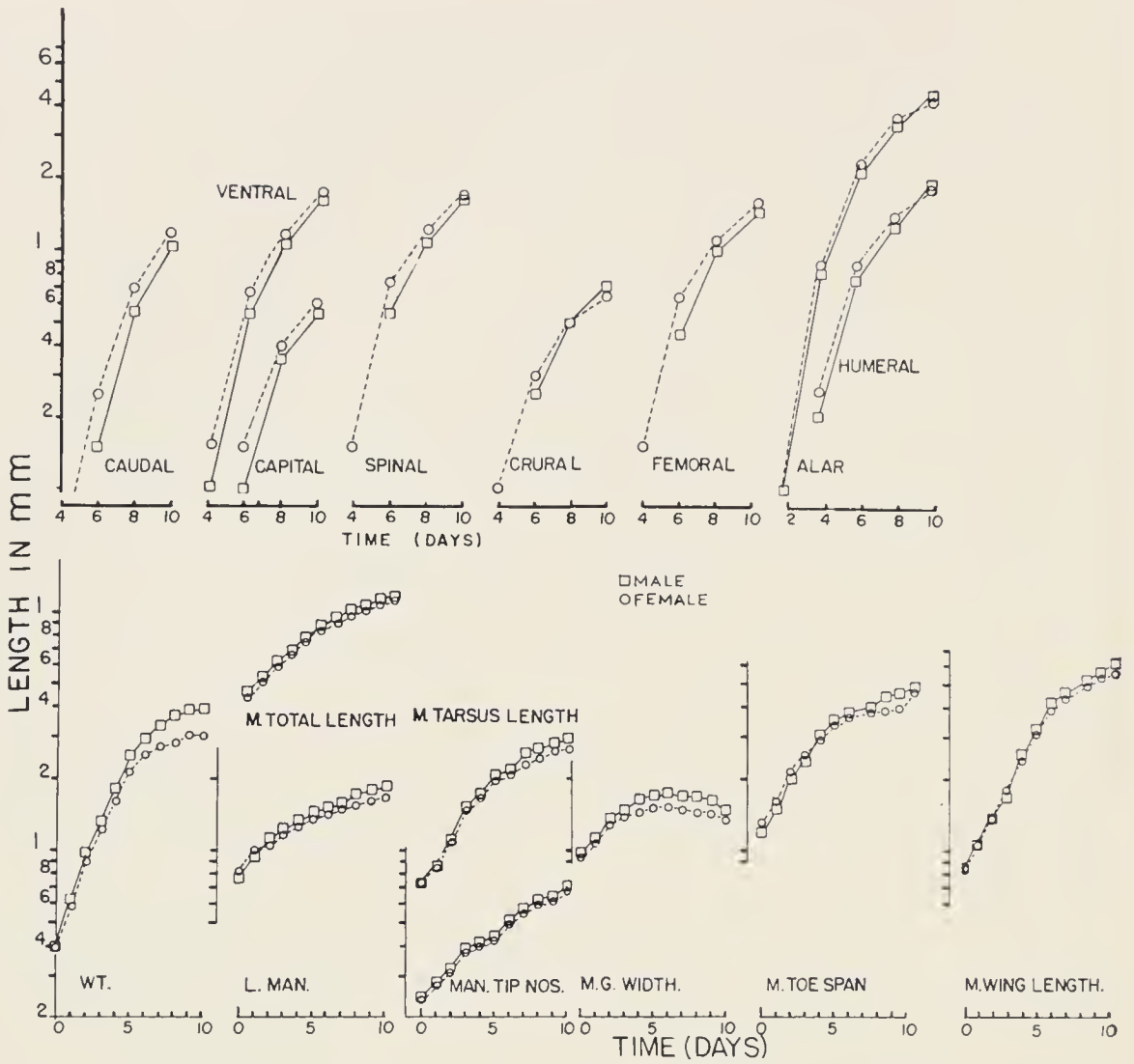

FIG. 1. Mean values are plotted in a semilogarithmic fashion for increase in weight (grams) and length (mm) of other body components and eight feather tracts of male and female Redwing nestlings. The smallest value is 0.5 mm; the greatest is 116.7 mm.

RESULTS AND DISCUSSION

Mean growth and growth rates.—Figure 1 shows the growth in weight of males and females on a semilogarithmic scale. There is a distinct separation of the growth curves for male and female nestlings and the slopes were significantly different.

Figure 1 shows the increase in weight and growth in length of different anatomical regions through day 10, and Table 1 shows the instantaneous relative growth rate (R). The mean growth increments are greater each day for male nestlings but not significantly different except for weight.

A simple index was calculated to show mean values of the rates of growth over the entire nestling period, i.e., the R (rate) values were summed for each characteristic and then divided by the number of days. The mean rate of

Table 1

Redwing Male and Female Nestling Instantaneous Relative Growth Rates (R) for Weight and Other Characteristics

Day	Sex	N Wt.	R Weight	N Other char.	R Lower mandible	R Mandible tip to nostril	R Gape width	R Toe span	R Wing length	R Total length	R Tarsus length
0	M	47		34							
	F	58		36							
1	M	42	45	29	19	16	18	20	18	11	21
	F	61	43	37	18	16	18	22	20	13	22
2	M	43	46	30	18	15	19	26	27	15	25
	F	60	42	38	15	13	15	24	28	12	22
3	M	44	33	31	10	14	8	20	28	11	23
	F	61	34	36	12	16	9	22	31	13	25
4	M	42	34	29	10	12	6	23	37	13	22
	F	53	27	33	8	9	4	18	30	12	19
5	M	42	25	32	6	12	2	14	28	11	16
	F	58	24	36	7	13	1	13	28	9	16
6	M	46	18	34	5	9	2	8	21	7	12
	F	60	14	36	2	8	0.4	6	18	6	12
7	M	45	11	32	3	10	−2	5	13	7	10
	F	63	7	39	3	10	−1	4	13	6	5
8	M	41	7	28	4	8	−0.3	5	11	4	5
	F	56	4	38	2	7	−1	1	9	6	4
9	M	34	8	23	1	7	−2	2	8	6	2
	F	40	5	29	2	6	−1	3	7	6	2
10	M	22	2	18	3	3	−5	3	8	4	4
	F	20	1	17	1	4	−5	2	5	4	0.3
Index	M		23		8	11	5	13	20	9	14
	F		20		7	10	4	12	19	9	13

growth throughout the entire nestling period could then be compared for each component. Rates of growth were somewhat faster for males than females in most cases but there were no significant differences. Gape width was the only characteristic declining in size after day six. This was due to a decrease in the fleshy rictal portions. The index for growth over the 10-day nestling period indicates the relative growth of different portions of the body.

Table 2

Projection and Fringing of Feather Tracts in Male and Female Redwing Nestlings Given in Percentage of Individuals where It Has Occurred

			Caudal		Capital		Spinal		Crural		Femoral	
Day	Sex	N	P	F	P	F	P	F	P	F	P	F
3	M	40			3		25		3		13	
	F	52			6		44		8		38	
4	M	38	11		8		95		76		95	
	F	48	42		27		98		85		100	
5	M	39	79		59		100		100		100	
	F	53	85		79		100		100			
6	M	38	100	3	100			21		18		29
	F	53	100	6	100			49		42		51
7	M	36		44		8		94		92		97
	F	53		49		32		98		92		94
8	M	32		100		100		100		100		100
	F	46		100		91		100		100		100
9	F	46				100						

			Alar		Humeral		Ventral	
Day	Sex	N	P	F	P	F	P	F
1	M	39	5					
	F	54	12					
2	M	40	93		3			
	F	55	95		9			
3	M	40	100		50		28	
	F	52	100		62		48	
4	M	38			100		95	
	F	48			100		100	
5	M	39		8			100	
	F	53		19		8		15
6	M	38		87		68		71
	F	53		94		74		87
7	M	36		100		100		100
	F	53		100		100		100

Projection, fringing, and growth of feathers.—Table 2 shows the percentage of each sex that had feathers projecting from the epidermis and the capsules fringing on the ends. The females had feathers projecting and fringing somewhat earlier than males.

TABLE 3

REDWING MALE AND FEMALE FEATHER TRACT INSTANTANEOUS PERCENTAGE GROWTH RATE (R)

Day	Sex	N	Caudal	Alar	Humeral	Capital	Ventral	Spinal	Crural	Femoral
3	M	28		115						
	F	32		126						
4	M	26		100	124					
	F	33		87	106		119	127		146
5	M	30		57	82		99	103	76	84
	F	36	97	52	77		84	82	78	83
6	M	27	78	41	51	95	61	64	60	64
	F	34	82	37	45	84	55	61	54	54
7	M	24	69	24	32	59	38	41	25	44
	F	33	69	24	31	56	40	33	35	37
8	M	20	46	21	25	47	29	30	33	29
	F	28	40	16	17	29	22	25	11	17
9	M	16	39	15	22	27	25	20	16	25
	F	23	35	15	20	24	22	18	21	20
10	M	12	26	11	16	20	22	23	24	18
	F	13	21	7	9	11	14	13	7	15
Index	M		52	67	63	50	50	52	42	49
(for first five days)	F		64	65	55	41	64	66	40	67

Figure 1 shows the mean growth of feathers and Table 3 shows the rate of growth in the different feather tracts. Males and females had feathers of about the same length at fledging. An index was obtained by calculating the mean of the growth rate for only the first five days of growth for each feather tract because the caudal and capital tracts did not appear as early as the other feather tracts and comparative values were desired.

The feathers grew at a faster rate than other characteristics measured. This is necessary if they are to provide their function by the time fledging occurs.

Sexing nestlings by weight.—The sex was determined by weight after nestlings reached an age of eight to ten days. Males had an overall different appearance. Their feather cover developed slower than females and they were more clumsy in their movements. Each individual was marked so that weight increases could be traced backward in time. The values for weights of nestlings are shown in Figure 2. There is overlap in weights of males and females yet on day 10. On day seven, 24 of 64 females weighed 27 or more grams and

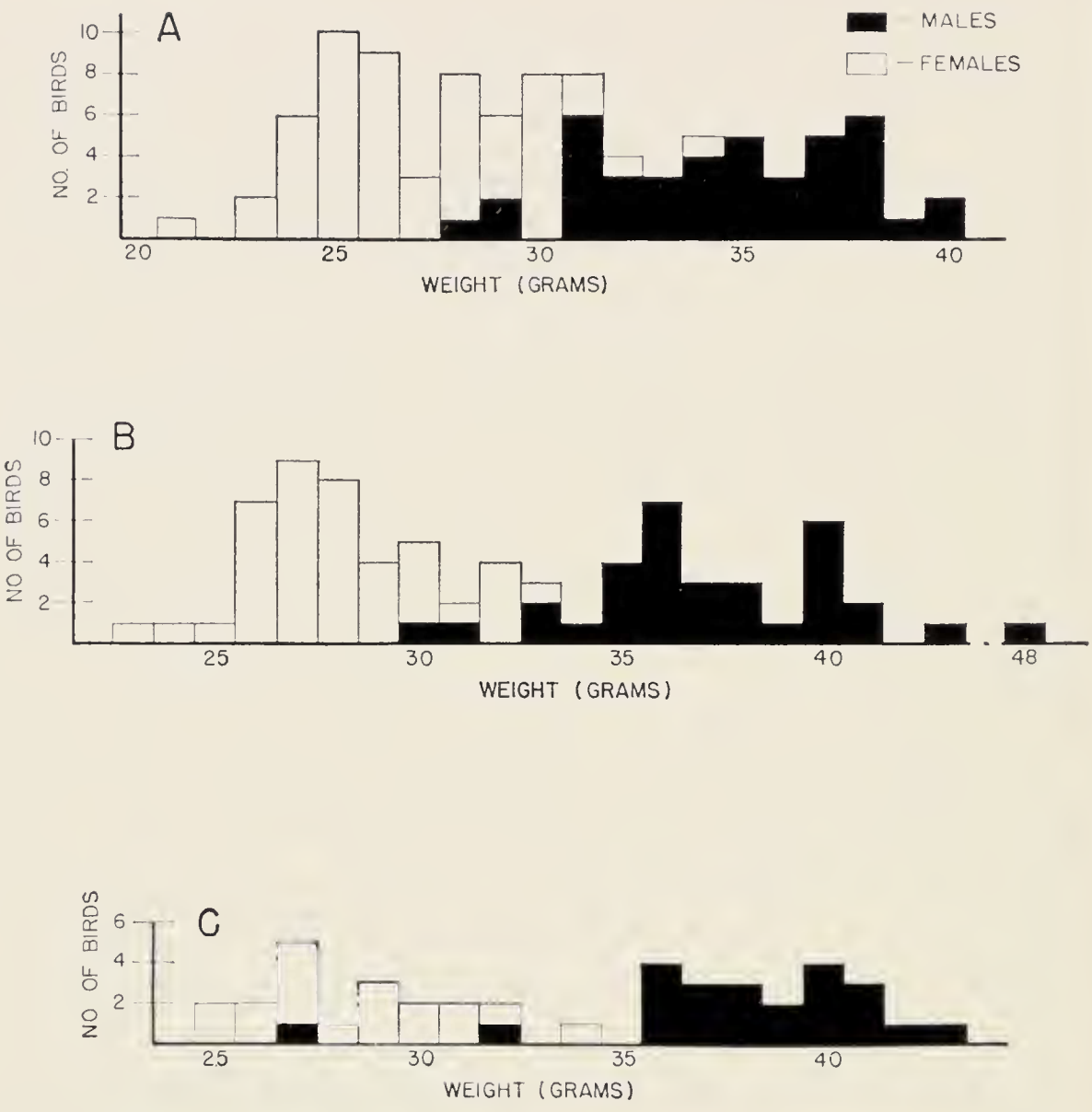

FIG. 2. Weights of Redwing male and female nestlings on A) day 8; 95 birds. B) day 9; 75 birds, C) day 10; 41 birds.

two of 45 males weighed less than 27 grams. Nero (1961) reported that Redwing nestlings could be sexed on the basis of weights beginning on day seven: 7th day—female below 27 g, male above; 8th day—female below 30 g. male above; 9th and 10th days—female below 33 g, male above 36. Williams (1940) reported too much overlap yet on day seven. His method on day eight was the same as Nero's. Williams' data for day nine indicate all females are 33 grams or below and all males 37 grams or above, and for day 10. females 33 or below and males 38 or above. If we used either of the methods proposed by Nero or Williams to sex our nestlings, we would have made several errors. We concede that it would be impossible to show a method that would work

without failure in sexing Redwing nestlings. We would prefer not to recommend criteria for determining sex before day eight. Even then, there will be some error when using only weight. We would prefer to make these recommendations for sexing nestlings of known age: Day 8—female under 31 grams, male 31 grams or over; Day 9—female under 33 grams, male 33 grams or over; Day 10—female under 33 grams, male 35 grams or over.

Ratio of males to females fledged.—The egg sequence producing males and females was: egg one—16 males, 24 females; egg two—20 males, 19 females; egg three—11 males, 15 females; egg four—4 males, 10 females. The sex was determined for 50 males and 68 females. Of this group, 41 males (82 per cent) and 54 females (79 per cent) were successfully fledged.

The mean duration of nestling life is shorter for females than males (9.2 vs. 9.7 days). The reasons for earlier fledging in females may well be that they obtain the adult size faster. The feathers project and fringe a little earlier in females and by day nine they are as long or longer than males in every tract. There is also faster feather development compared to total body weight. For instance, the first primary (alar tract) has the same mean length for males and females on day nine. On day nine, males weigh a mean of 9.2 more grams than females, and the length of the wing is only 3.2 mm longer. This would suggest that the females leave earlier, because they have lighter wing loading than males.

We believe that there may be no difference in the ratio of males to females in the first summer, and if there is any difference, it may favor females. Males stay in the nest somewhat longer than females. As young are more subject to predation than eggs (Young, 1963), more females may be fledged. The capture of more males than females in mist nets (Meanley, 1964) and live traps (Giltz, pers. comm., and trapping by Holcomb) may result from males being attracted to other birds in a trap, due to aggressive or gregarious tendencies. Perhaps males respond faster to calls of individuals already captured. The more aggressive nature of males may also make them less timid than females in approaching a capturing device. This same lack of timidity may also make them more vulnerable to predation than the females, and thus contribute to an excess of females for a polygamous mating system (see Selander, 1965).

SUMMARY

The b values for the slope of the growth curves for weight of Red-winged Blackbird male and female nestlings showed a significant difference ($p < 0.05$); the males grew faster.

An index for rates of growth for weight, lower mandible, mandible tip to nostril, gape width, toe span, wing length, total length, and tarsus length showed that males grow faster only in weight. Growth rates are presented for eight major feather tracts of males and females; there were no sexual differences.

Feather capsules project from the epidermis and fringe on the ends in a greater percentage of females earlier than males. Therefore, although feathers grow at a little faster rate in males, females have feathers nearly the same length in each tract near fledging time.

Red-winged Blackbird nestlings can usually be sexed on the basis of weight by day eight. However, there was some overlap in weights of male and female nestlings on day 10. A revision of a method for sexing nestlings on the basis of weight is given.

A ratio of males to females hatched from eggs of known laying sequence is given. The sex was determined on 50 males and 68 females of which 41 males and 54 females fledged. A *secondary ratio* of 50 : 50 is suggested and hypotheses for reasons leading to an adult ratio in favor of females are given.

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REQUESTS FOR INFORMATION

Desire data on body and/or feather weights in California quail and ring-necked pheasant for Ph.D. research topic. Especially desire data from limited circulation or unpublished sources. Can also utilize similar data on other phasianid species. If possible, please list individually with date, location, sex of bird, age of bird if determinable and name of collector. Send to Carl Phillips, Dept. of Zoology, U.B.C., Vancouver 8, B.C., Canada.

During the autumn migration of 1970 the Ontario Bird Band Association hopes to band and color-mark several hundred Semipalmated Sandpipers and Sanderling at Long Point, Ontario. Information on the movement of these sandpipers is essential to research presently underway on the energy requirements of their migration. We would greatly appreciate it if anyone sighting these birds would report their observations to Dr. A. Salvadori, Department of Mathematics and Statistics, University of Guelph, Guelph, Ontario.

The following information would be appreciated; Species: Location: (including nearest city or town) Dates: Color: (birds will be colored on the breast or abdomen with a single color, either pink, orange, blue, green, yellow or purple). Leg that has been banded: (This will tell if the bird is an adult or an immature.)

Any information on what other birds are with the marked individuals would be very useful.